Mall

THE ANATOMICAL COURSE AND LABORATORY OF THE JOHNS HOPKINS UNIVERSITY.

By Franklin P. Mall, *Professor of Anatomy, Johns Hopkins University.*

[From *The Johns Hopkins Hospital Bulletin*, Nos. 62-63, May-June, 1896.]

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Three years have now passed since the teaching of anatomy was begun at the Johns Hopkins University. A number of radical changes were introduced into the course, and during the first year a new anatomical laboratory was constructed. The methods of teaching, as well as the laboratory, I believe to be a success and therefore make the following publication.

The literature on the construction of anatomical laboratories is extremely brief. Descriptions of some of the European institutions have been published in detail, and I have found that by His* the most valuable. He describes a carefully planned building accurately, giving aims and ideals as well as difficulties to be overcome. In America we cannot boast of the multitude of buildings erected especially for the teaching of anatomy and investigation in this subject. This lack is to be the more regretted because we have many problems peculiar to this country. Our students and our climate are both unlike those in Europe, and yet in our many medical colleges the most fundamental branch in medical science is treated in a very shameful way. The dissecting room is as a rule poor, while the laboratory facilities for microscopical study are usually wanting altogether. A few of our leading institutions are marked exceptions to the above statement.

The object of the laboratory is to teach students, to train investigators, and to investigate. Although the first mentioned requires the greater portion of the instructor's time, its importance is by no means as great as the second and third. A subject like anatomy, taught for many centuries, has recently been made a new science through the studies in

* His, Zeit. f. Anatomie, Bd. II, 1877.

embryology and histology. The studies in embryology have gradually become more and more comparative in nature, and in turn have influenced to a very great extent our conceptions of comparative anatomy. The great influence of histology is not yet fully felt outside of the study of the higher animals, but its importance has been shown over and over again in the branches fundamental to medicine.

The laboratory method of instruction has become very firmly established in many of our colleges in their under-graduate courses, but in medicine the *results* are yet taught to a great extent by means of lectures. Our problem is the study of the structure and the development of the parts of the human body, utilizing all the methods at our disposal to instill these facts into the student's mind. The aim is to make the course one continuous problem for each student to investigate, aiding each one with good material, and teaching him how to study, wherever necessary.

The instructor soon learns the value of investigation, even in the dissecting room, and with this ideal constantly in view, he soon imparts a portion of it to his students. When anatomy is studied in this way, the student must indeed be stupid not to discover the many defects as well as errors in some of our favorite English text-books.

No subject has been taught more carefully nor in greater detail than anatomy. It has been taught by the greatest minds, and has been presented by means of printing and engraving ever since these arts have been invented. Yet in looking over the history of men like Vesalius and John Hunter, one is struck with the fact that they taught it from the human body. They had their battles to fight and even to risk their lives to procure human bodies for dissection. They had to antagonize the prejudice against dissection at that time, as many of us in America must to-day.

But with all the good examples shown us by our great predecessors, the tendency has been to teach more and more by means of lectures; and although dissection has grown very popular, it is usually done very poorly and sometimes not at all. In Europe the lecture courses have, in many universities, become gigantic in extent, and the only thing which can stop any of them is a total lack of students.

I have asked many professors, even of anatomy, where they had learned their anatomy, and in nearly all cases the reply was "in the dissecting room." They all admitted that in addition to demonstrations, lectures were of little use to students, and some believed them worse than useless. The zoölogists and botanists have long ago learned the absurdity of the lecture method of teaching, but the anatomist patiently keeps up this slow and stupid method of instruction. It is stupid because no anatomist would use this same method if he were to learn instead of to teach.

We know very well that the burden of responsibility is removed, to a great extent, if the instructor goes over the whole subject carefully once a year. He then can tell his student to go to the dissecting room to see for himself. If the student does not attend the lectures, the professor carries no responsibility, no matter how uninteresting or uninstructive they may be. Yet the beauty of the courses of lectures is that the professor carries no responsibility if the student does not know his anatomy.

I believe that there is but one way to learn any subject, and that is through study. The very name *student* tells what the person so named should be doing; and with a natural science, dealing with a most complex object, extending through the three dimensions of space, any other method besides studying the object itself is practically useless.

Lectures with demonstrations are certainly valuable—more valuable than the lectures with text-books alone. Yet analyzing the object itself is infinitely more valuable than to watch the results exposed by another. Wrestling with the part which is being studied, handling it and viewing it from all sides, and tabulating and classifying the parts worked out, give us the greatest reward. All this may be accomplished by practical laboratory work. If we can make the student work thoughtfully and carefully, a great result is achieved. It makes of him an artist, an actor, an expert, not a dilettant. He is upon the stage, not in the audience.

If, now, all the energy which is expended in conducting extensive lectures is employed in managing a dissecting room, we will find to our astonishment that this ideal can be reached in a certain number of cases. It is not difficult to keep

account of the many details of the work, for there are many people in business who easily manage much greater accounts with precision. So this difficulty must be placed aside as one easily overcome. In our laboratory we can tell, though asked at almost any time, what any of the 70 students have done during the year. Also we can give the complete history of any of the subjects dissected. For instance, in Subject No. 70 the first lumbar nerve arose in such-and-such a way and was distributed through the branches to certain regions. It was dissected by Mr. Smith during a certain month. There were in this subject 24 vertebræ; it was white; a male, about 50 years old; was embalmed with carbolic acid and had been in cold storage for 15 months, etc. Mr. Smith's dissection was excellent, good, indifferent, or bad; his knowledge of the subject was also excellent, good, indifferent, or bad; he dissected certain parts poorly, others well, and so on. These records are all kept by the various instructors and are finally recorded upon cards, each representing the part dissected. This method is carried through for osteology, histology, neurology, and embryology, and finally, when the student appears for examination, we have his complete record before us.

In arranging the course on anatomy at this University, very great stress was laid upon the microscopical work. Although this course is conducted separately and independently of that in gross anatomy, they are, however, adjusted to each other in every respect. Much of the advance in modern anatomy is due to the microscope, and we believe that if an anatomical course is robbed of this sub-department it loses its most important support.

In many of the medical institutions of this country, histology is not in charge of the department of anatomy, and often is not represented at all, or at best by too brief a course.

In Europe, histology is often an independent department (as in Austria), or it is frequently subordinate to physiology. There is no harm whatever in giving a histological course in departments other than anatomy, but anatomy must not be robbed of its privilege of conducting such a course. Histology has found its home principally in Germany, and in that country every anatomical institute has associated with it his-

tology.* Waldeyer says that anatomical instruction and research should be carried on as far as possible with the naked eye and then continued with the microscope.† This has been our ideal in the planning of our course and in the construction of our laboratory. When a course is conducted in this way it requires much space, extensive apparatus and a large number of instructors. In Leipzig much space is saved in utilizing the same room for both courses: anatomy in the winter and histology in the summer.‡ This gives an abundance of room for microscopical work, for in all cases more space is required for the course in gross anatomy than for histology. In the Leipzig laboratory a special room containing a floor space of 114 square metres had been constructed for histology, but it was found to be too small, and the course had to be transferred to the large dissecting room, which contains 210 square metres floor space. In Berlin 200 students must be accommodated, and two parallel courses are given in a room containing 153 square metres of floor space.§ But Waldeyer deplores the fact that they are cramped in space, which is a very serious difficulty.

Our histological laboratory has an area of 150 square metres, and is intended to accommodate 50, or at the highest 60 students. If necessary other rooms may be used for the same purpose, which will enable us to instruct a much greater number in histology. Each student is supplied with a working place and locker, containing in addition to Leitz microscope II with Abbe condenser, a suitable dissecting microscope. All the necessary reagents are obtained in the laboratory. The course extends through 15 hours each week, from October 1 to March 15, but most students do some work during odd hours, as the laboratory is open all day.

The aim, throughout the course, is to begin with the fresh tissues, and to end ultimately with many of the complex methods in demonstrating the structure of difficult organs,

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* See Waldeyer in Die Deutschen Universitäten (Report to the University Exhibit at Chicago, 1893), Berlin, 1893, Bd. II.

† Waldeyer, Wie soll Man Anatomie lehren und lehrnen, Berlin, 1884.

‡ His, Zeitschrift für Anatomie und Entwicklungsgeschichte, 1877.

§ Die Anstalten und Einrichtungen des öffentlichen Gesundheitswesens in Preussen, 1890.

like the brain. Suitable charts, models, dissections as well as projection of specimens are employed whenever necessary. In a general way we dissect as far as possible in the dissecting room, and continue with the microscope in the histological laboratory.

During the first year a practical course was given in the embryology of the chick, but it was found unnecessary to continue this with many of the students, as most of them have had an extensive course on embryology before they begin the study of medicine. However, embryology is alluded to frequently in our courses in practical anatomy and histology, and each organ is also presented from the standpoint of histogenesis.

Our laboratory has been designed especially to carry out our ideals, and during its construction we have constantly kept before us the following points:

Light.

Heat and ventilation.

Basement planned to manage heat and for the reception of anatomical material.

Cold storage and embalming rooms.

First floor, lecture room, etc.

Second floor for histology, which was planned in connection with the work on anatomy.

Photography, dark room for reconstruction, chart-making, etc.

Research and preparation room. Private rooms.

Third floor to contain a multitude of dissecting rooms, each complete in itself.

A study room.

Models displayed in the rooms when needed.

Suitable lockers and rooms for the use of students.

An abundance of storerooms. Storeroom for combustibles.

Animal house and aquaria.

Bone room.

Light.—The great majority of laboratories are very poorly lighted, and this is a very serious defect. In many of the American medical colleges the dissecting room is on the top floor, with an additional skylight. This is a most superior method of illumination, and we have adopted it not only in this laboratory but also in the pathological.

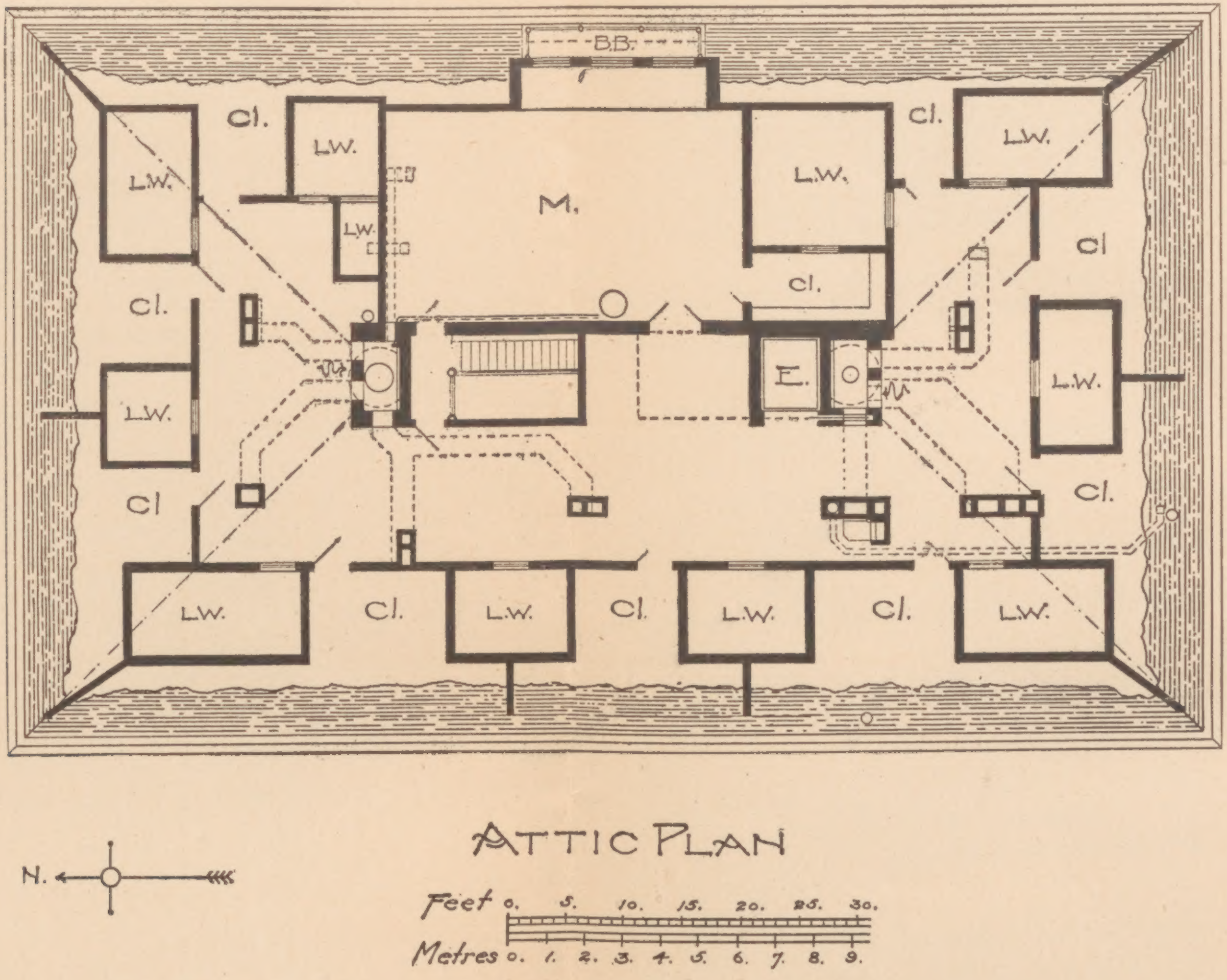

FIG. 13.

M, Macerating room. *LW*, Light well. *Cl*, Closets. *E*, Elevators. *BB*, Bleaching balcony.
The dotted rectangle as well as the square over the stairs mark the light wells in the central portion of the building.

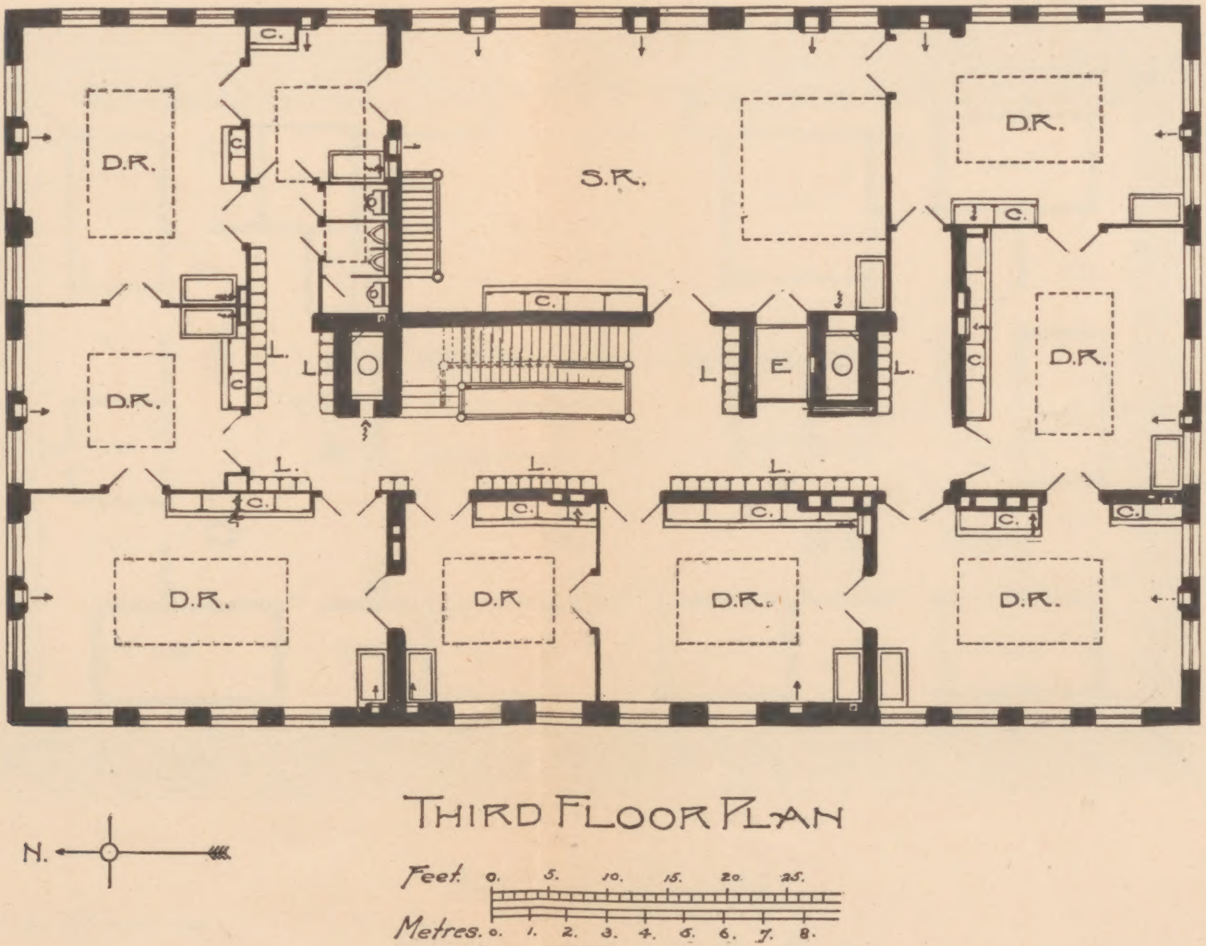

Fig. 10.

DR, Dissecting room. *SR*, Study room. *C*, Cases. *L*, Lockers. *E*, Elevators.
The dotted rectangles around *DR* indicate the extent of the light wells. The lighter partitions indicate that the walls are thin and can be removed easily.

First and foremost in the building is a great central light shaft, in which are placed the stairs and the elevator (see Fig. 13). This gives an abundance of light for the stairs and the upper floors, but we did not trust to this light alone for the illumination of the halls. There are about as many windows as possible in the building. They are wide, and reach nearly to the ceiling, thus giving ample side light for each room. The large rooms on the north side receive light from all three sides, thus making it possible to work with the microscope in any part of the room. Over each door entering the hall there are large transom windows, which aid in the illumination of the halls. On the first floor the hall is illuminated with a special window, thus giving all of the halls throughout the building splendid light.

Each room on the third floor has, in addition to this abundance of side light, a large skylight (see Figs. 10 and 13). The rooms are protected from the cold by a special layer of glass on the level with the ceiling. These light shafts communicate with the attic floor by means of windows, which give additional light to this floor, and give an entrance to this shaft from the inside of the building to clean the skylights.

The balcony on the fourth floor connects with the fire escapes as well as with the roof, so it is possible to go to any portion of the building as well as through the ventilating shafts without constructing any scaffolding or breaking any of the walls.

Heat and Ventilation.—The heating and ventilating systems of the building are very perfect. Cold air, obtained through the windows of the basement, is heated by means of steam coils and then allowed to pass to the rooms through shafts in the outside walls. The Arabic figures in the Basement Plan indicate the floors with which the shafts communicate, 1, to the first floor, and so on. Each room in the building has its own hot-air shaft, and in no case does one shaft go to two stories. There is an abundance of heat, which can be cut off from the room or from the basement, as will be described further on (see Fig. 1).

The ventilating system is by means of two large central shafts, which grow larger and larger as the top of the building is reached, to make room for the additional air entering

the shafts from the upper floors. In the center of the north shaft is the smokestack, and in the other the steam exhaust from the engine. In addition to these pipes there is a steam coil in each shaft which aids to heat the air in the shaft, making a constant upward current of air (see various Ground Plans).

In all cases the communication with the shaft is near the floor of the room and on the side of the room opposite the entrance of warm air. The ventilating registers of the larger rooms near the shaft enter it directly, while those somewhat distant pass up the partition walls and communicate with the shaft immediately below the roof (see Fig. 13).

During two years' experience we have never had gases or odors to enter the shaft and to come out again on the floor above or below, as the suction force of the shaft is sufficient to carry everything entering it to the outside of the building.

The macerating room as well as all of the closets have their own special ventilating shafts communicating with the roof, as the laws of Maryland prevent their being connected with the main shaft.

The elaboration of the building was made by Mr. Archer,* and that of the heating system by Mr. Newton of the firm of Bartlett, Hayward & Co.† I am under obligations to Mr. Archer for the interest he has taken in our problem, as well as the willingness he has shown in adopting plans to overcome our difficulties.

The Basement.—The basement is partly above ground on the south, and wholly above ground on the north side. Its plan is shown in Fig. 1. On the north side there is a drive, *D*, through the whole building, which facilitates the handling of bulky apparatus as well as the reception of anatomical material. This drive is one of the most practical arrangements of the whole building. Very close to the drive is a sub-basement containing the boilers, *BP*. Communicating with the boiler pit is an arched vault, *CB*, extending below the sidewalk, which can be filled with fuel from the street. A

* Mr. George Archer, Central Savings Bank Building, Baltimore, Md.

† Bartlett, Hayward & Co., Baltimore, Md.

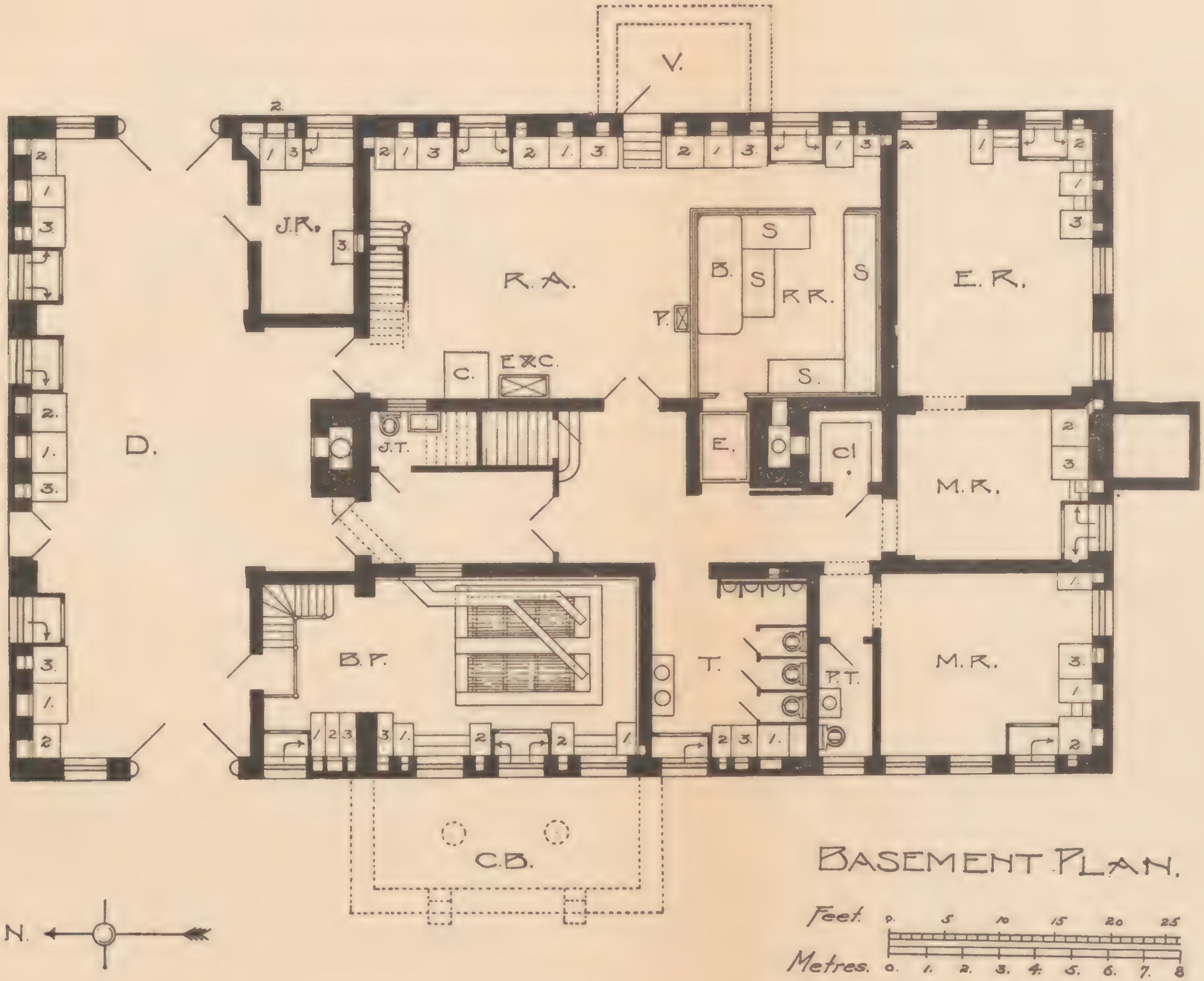

FIG. 1.

D, Driveway. *RA*, Refrigerating apparatus. *C*, Condenser. *E & C*, Engine and compressor. *P*, Pump. *B*, Brine tank. *RR*, Refrigerating room. *S*, Shelves. *ER*, Embalming room. *MR*, Machine room. *BP*, Boiler pit. *T*, Toilet. *PT*, Private toilet. *E*, Elevator. *Cl*, Closet. *JT*, Janitor's toilet. *JR*, Storage room. *V*, Chemical vault. *CB*, Coal bins.

The figures 1, 2 and 3 in the boxes communicating with the hot-air shafts indicate that the shafts communicate with the **first, second and third floors respectively.**

hall extends through the basement, and from this the elevator, *E*, communicates with all the floors above. In addition to this there are the embalming room *ER*, the engine room *RA*, storage rooms *JR* and *CL*, cold storage vault *RR*, chemical vault *V*, machine shops *MR*, and toilet rooms *T*. The dark parts of the basement and the vaults are illuminated with electric light.

The whole system of heating, as well as the hot and cold water pipes and drainage, are all exposed in the basement. Nothing is buried and out of reach. A certain number of windows are utilized to obtain the air from the outside, by boxing them off with a large second window. This space communicates by means of large shafts with the sheet-iron boxes containing the steam coils. From these boxes the hot air passes through the hot air shafts to the various floors above, as indicated by the figures 1, 2 and 3. Each room is heated with its own shaft, and each shaft has its own hot air box. The circulation of hot air can be regulated from the room above as from the hot air shaft below. Moreover, the steam for any shaft or set of shafts can be cut off by closing the valve of the steam pipe passing to the respective hot air boxes.

There are two boilers, either or both of which may be run at high or low pressure without interfering with the heating apparatus. Whenever it is necessary to operate the engine it is necessary to run at least one boiler at high pressure. The capacity of the boilers and engine is sufficiently large to operate any machinery we may need in future.

The garbage of the building is all cremated in the basement.

The Preservation of Anatomical Material.—The supply of anatomical material for dissection and the laws regulating it in Maryland are such that it influences materially the plan of our course in anatomy. Not only is the material scarce, but our most abundant supply is obtained during the summer months when the weather is extremely warm. These facts compel us to resort to rigid methods in its preservation as well as in its dissection.

We have tried a great variety of methods to embalm bodies and find none more excellent than the carbolic acid mixtures.

Even the formaldehyde solutions appear to be inferior to it. I prefer to use enough carbolic acid to coagulate all of the muscles, as this destroys the odors completely, and then the parts will not decompose while they are being dissected. This is accomplished with about one kilogram of the pure acid diluted sufficiently with alcohol and glycerin. It is well to mix them in thirds, or in the ratio of one of acid to two of glycerin and two of alcohol. Simply injecting this fluid into a large artery with a syringe by no means sends the fluid to all parts of the body in every case. It is necessary to inject it gradually under a constant pressure. In our laboratory we have a constant pressure apparatus in the embalming room, which can be regulated with ease up to two atmospheres (Fig. 2). About 5 to 7 lbs. to the inch pressure are usually sufficient to distend all the arteries of the body thoroughly. With this pressure about 4 to 6 quarts of the fluid is gradually forced into the femoral artery. A double cannula is employed, injecting both the peripheral and central ends at the same time. It is easy to tell by the appearance of the skin when the body is well injected. The coagulation in the skin about the neck and arms usually appears first, then the face, and finally that of the leg opposite the one in which the femoral has been cut. These marks indicate that the deeper parts have been well injected.

The body is now allowed to remain in the room for from 12 to 24 hours, when the second injection is made to color the arteries. I have never fully understood why the Europeans have had such difficulty in filling the arteries to their satisfaction for the dissection room. I find plaster of Paris colored with red lead eminently satisfactory; it is easily handled and never flows from a cut vessel. We inject a very fluid plaster colored with red lead under a high pressure (about 10 lb. to the square inch). Two quarts of this fluid will flow into the arteries in the course of a minute or two, and then it is immediately allowed to flow out. This procedure distends all of the small arteries and leaves practically no plaster in the large vessels, for the plaster remains in the small arteries but flows out again from the large ones.

Subjects treated in the above-mentioned manner can be kept for a long time in almost any fluid, and also in an ordinary

Fig. 2. Injecting Apparatus in the Embalming Room.

The upright tank is connected with the water main, from which it is filled, thus giving a large quantity of compressed air. This is used to drive the embalming fluid into the arteries.

ice-box (40° F.). I have kept them in the latter for over a year, but there is a tendency for the feet and hands to mould. These are not perfect methods, and when they are employed they have a marked tendency to make the dissecting-room disagreeable and dirty.

When well embalmed subjects are placed in cold storage (below 32° F.) they may be preserved indefinitely. Yet, simply freezing the subject does not accomplish the object perfectly. We are in the habit of believing that cold air is dry and will prevent evaporation, but even at a very low temperature (20° F.) there is a marked evaporation. Our vault is cooled from above, and the slight difference of temperature between the floor and ceiling of the vault is sufficient to dry completely the fingers and toes of the subject in the course of six months. This moisture, which leaves the floor of the vault, forms into large icicles about the steel pipes immediately below the ceiling of the room.

I have often been struck with the remarkable property of the epidermis to prevent the drying of the skin, even after it has been in a warm room for several months. This property can be increased to a very great extent by oiling the skin, a method we employ altogether to prevent our subjects from drying while the dissection is taking place. Vaselin is much superior to oil, and after many trials we use it exclusively to keep the skin soft and moist, both in the cold storage and in the dissecting room.

After the body has been embalmed it is smeared over with a large quantity of crude and cheap vaselin, and then wrapped with the continuous roll of water-closet paper. A second coating of vaselin in places over the paper covering the feet and hands and then the whole body is wrapped in muslin. This mummy-like body is now frozen and preserved in the cold storage. I have now kept subjects treated in this way for two years in the cold storage, and when placed upon the dissecting table they have all the appearance of fresh bodies. The wraps are not removed from the legs and arms until they are about to be dissected; they prevent the skin from drying before it is removed.

My experience, therefore, shows that subjects may be pre-

served perfectly and in the natural condition for years with carbolic acid, vaselin, and freezing.*

The Freezing Apparatus and Vault.—In applying cold storage in our laboratory it was necessary to adjust it to the heating apparatus of the building. The boilers for heating the building are 60 horse-power strong and are employed during the daytime of the winter only. It was necessary that they be high-pressure boilers, while the heating apparatus of the building requires low-pressure steam. If this could not be the case it would be necessary to add an additional boiler, calling for, in all probability, an additional fireman with additional expense for coal during the winter. This difficulty was overcome by the introduction of a reducing valve between the boilers and the heating system, which reduced the steam pressure to about one atmosphere for the heating, leaving high pressure in the boilers for the engine. The exhaust steam from the engine is allowed to escape into the heating apparatus, and thus performs an additional work in heating the building after it comes from the engine. An automatic pump forces the condensed steam back into the boilers.

The engineer is in the building during the daytime only, so we desired to construct our apparatus in such a manner as to accomplish the work for the whole twenty-four hours by operating the engine during the daytime only. If this were not the case it would cause a considerable extra expense to run the machine all night. This obstacle we overcame most successfully. In fact our ice machine and vault can do all the work we desire of it by working but a few days *per week*.

Then the apparatus must be relatively inexpensive. Before deciding upon the machine we purchased, we communicated with a number of firms, and believe that we have procured the cheapest as well as the best. Our machine and vault were constructed by the Remington Machine Company of Wilmington, Delaware, and cost considerably less than $4000. The

* The different methods employed in the various medical colleges in America for the preservation of anatomical material have been published recently by a committee appointed by the Association of American Anatomists, *Science*, Vol. 3, 1896.

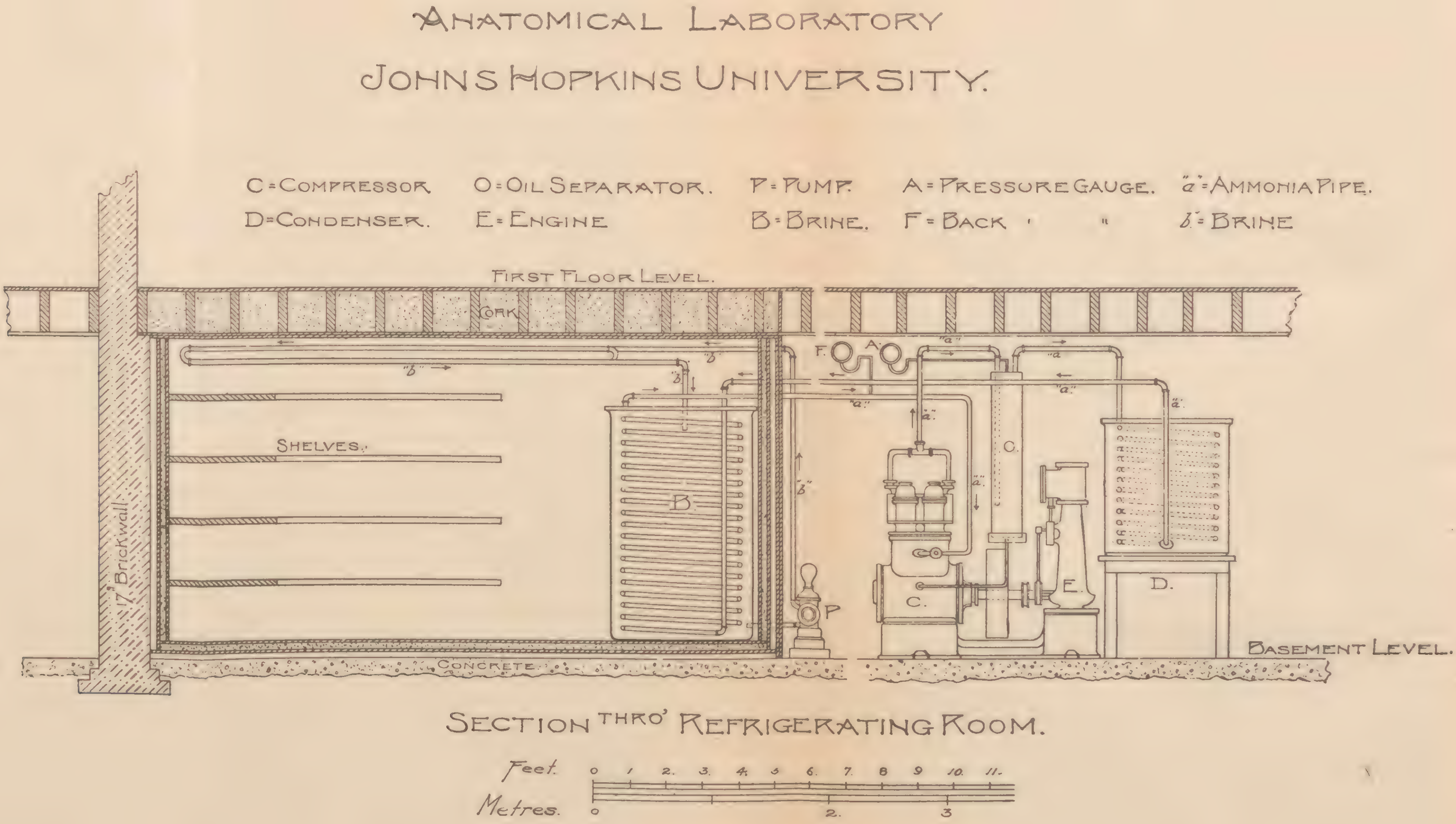

FIG. 4. PLAN OF COLD-STORAGE APPARATUS AND VAULT.

In addition to the insulation, as shown in the diagram, there is another two-inch air space covering all six sides of the vault.

FIG. 5. FLASH-LIGHT PHOTOGRAPH OF THE REFRIGERATING APPARATUS IN THE BASEMENT.

The vault is on the left, as indicated in the sectional view, Fig. 4.

cost of operating the machine in addition to our ordinary expense of heating the building has been less than $100 per year. The capacity of the vault is about 200 subjects, but can be enlarged sufficiently to supply all demands.

We purchased a two-ton machine, *i. e.* a machine whose refrigerating capacity in 24 hours is equivalent to 2 tons of ice; a photograph of it is shown in Fig. 3. This machine much more than fulfills our requirements, and may ultimately be used to cool a number of working rooms in the summer. Yet it is very desirable in the construction of any apparatus to have an excess of force at hand. Of the two systems employed for refrigerating a room we selected the indirect. In the direct method the compressed anhydrous ammonia is permitted to escape into coils of pipe suspended in the room through which the heat is absorbed. In the indirect method the coils of ammonia pipes are immersed in brine which is first cooled, and this cold brine is in turn pumped through a system of pipes suspended from the ceiling of the room (see Fig. 4).

In our apparatus the ammonia expands into a long coil immersed in 5 tons of strong calcium chloride solution, *B*. The operation of the engine, *E*, first cools this brine, which is now forced by an additional pump, *P*, through the pipes, *b*, along the ceiling of the vault, as the figure shows. The tank of calcium chloride brine is placed within the vault, and then when the machine is not running this great quantity of brine absorbs the heat which gradually enters through the insulated walls.

The vault is well constructed with a number of layers of boards, air spaces and mineral wool, as the diagram shows. Each layer of board is covered with one or two layers of paper; the outermost layer is tarred. The door is insulated in the same way and is over a foot thick. The interior is illuminated with electric light. There are thermometers on the outside which read the temperature of the brine as well as that of the air of the vault.

We found that in the beginning it was necessary to operate the machine for 36 hours continuously to reduce the temperature of the vault to 32° F. After this an additional run of the machine for 8 hours reduced the temperature of the vault

to 20° F. During this time the brine was circulating constantly through the tubes suspended from the ceiling of the vault. The temperature of the brine at this time had fallen to 0° F., and we have never attempted to reduce it lower. With the vault at 20° F. and the brine at 0° the machine may remain quiet for a whole week, at the end of which the temperature in the vault is 32° and that of the brine 25°. When the temperature of the vault has risen to 32° it is desirable to cool it again, because opening the vault frequently causes thawing, thus making the room very sloppy.

Date.	Temperature in Degrees Fahrenheit.						
	Outside.		Brine.		Vault.		
1895.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	Duration of Run.
November 11....	59	69	..	..	29	25	8 hours
12....	59	62	..	..	29	25	2
13....	61	61	..	..	28	25	8
14....	62	73	11	0	26	21	8
15....	72	78	8	..	24	22	9
16 ...	71	78	6	5	24	20	4
17 ...	.	..	..	..	.	..	0
18....	63	69	14	5	27	23	6½
19....	71	68	10	6	25	21	7
20....	70	73	10	2	26	21	8
21....	..	..	..	..	26	28	0
22....	60	..	..	..	29	..	0
23....	62	..	..	..	31	..	0
24....	..	..	..	..	..	..	0
25....	62	73	22	10	32	25	8
26....	72	78	13	2	28	23	8
27....	70	76	8	2	25	22	8
28....	..	..	..	..	..	..	0
29....	69	69	13	4	26	22	8
30....	70	76	9	0	24	21	6
December 1....	..	.	..	..	..	..	0
2....	64	76	12	0	26	21	7
3...	62	68	8	2	24	20	8
4....	56	57	..	..	27	26	0
5 ...	57	64	..	..	28	29	0
6....	56	62	..	..	29	30	0
7....	58	64	..	..	30	31	0
8....	..	..	..	..	..	..	0
9....	60	66	.	..	32	32	0
10....	58	67	25	8	32	23	8
11....	59	70	11	1	26	27	8
12....	60	64	..	..	28	29	0
13 ...	56	62	..	..	29	30	0

Date.	Temperature in Degrees Fahrenheit.						
	Outside.		Brine.		Vault.		
1895.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	Duration of Run.
December 14....	58	62	..	..	30	31	0 hours
15....	..	..	..	..	..	..	0
16....	49	48	..	..	32	32	0
17....	68	78	20	8	32	24	8
18....	70	78	8	2	29	20	8
19....	70	69	..	..	29	29	0
20....	68	68	..	..	30	31	0
21....	67	69	..	..	32	32	0
22....	..	..	..	..	..	..	..
23....	60	74	20	6	32	23	8
24....	72	78	11	2	27	21	10
25....	..	..	..	..	..	..	..
26...	76	74	8	2	27	20	10
27....	72	78	..	..	28	29	0
28....	74	78	..	..	30	31	0
29...	..	..	..	..	..	..	0
30 ...	68	..	18	..	32	..	8
31....	66	..	7	..	25	..	8
1896.							
January 1....	..	..	..	..	..	..	0
2....	68	72	..	..	28	29	0
3....	68	74	..	..	29	30	0
4....	64	68	..	..	30	31	0
5....	..	..	..	..	..	..	0
6....	58	60	..	..	32	32	0
7....	60	62	..	..	32	32	0
8....	64	67	20	8	32	25	8½
9....	68	72	11	2	27	20	10
10....	66	68	..	..	28	29	0
11....	68	70	..	..	29	30	0
12....	..	..	..	..	..	..	0
13....	61	68	..	..	31	32	0
14....	68	74	18	3	32	22	10

I have now taken the temperature of the vault, brine and outside room twice a day during a whole year, with the time the engine was running. The above table is a portion of this record.

The chart is not as complete as might be desired, for the brine temperature is not given for the time in which the machine is not running. This was not easily done, for it was necessary to start the engine to obtain the temperature of the brine. Our method of managing the apparatus is not to open the vault very much while the engine is not running. When

the vault is opened frequently during the day its temperature rises rapidly and necessitates starting the machine. The temperature records of December 2d and 3d are accounted for by the frequent opening of the vault.

After we are accustomed to a cold-storage plant for the preservation of anatomical material it is difficult to understand how we ever got along without it, as difficult as it is to get along without a microtome. It makes us commander of the situation for all times of the year.

In our anatomical course we employ extensively pigs' hearts and lungs, sheeps' heads and other material obtained from the slaughter-house. These materials are frozen and kept on hand constantly. The same applies to preservation of dissections during the holidays when students cannot attend to them. More important than either of these is the preservation of large dissections used in teaching. It dispenses wholly with the large alcohol vats. The large dissections are wrapped in vaselined cloths and simply labeled. It is as easy to manage such dissections as it is to care for a large model. Furthermore, the vault may be considered a large freezing microtome for cutting cadavers, or even for cutting serial sections on an ordinary microtome. And last, but not least, we preserve cadavers not suitable for dissection, as well as carcasses of animals until we are prepared to make skeletons of them.

Before we decided to adopt cold storage we obtained many valuable hints from Professor Huntington of Columbia College, New York, who had employed a machine similar to ours for a greater length of time. I am under many obligations to him for valuable recommendations. Yet our apparatus can be improved in a number of ways, the most important of which I believe to be the construction of two vaults, one within the other; the inner vault to be surrounded completely with the cold brine and to be used for freezing the bodies; the other vault to be used for preserving purposes, and to be kept at 32° F. or slightly below. In this case the engine could be used to cool the brine about the inner vault whenever necessary. Moreover, the outer vault should be surrounded with a brick or stone wall, as the expansion and shrinkage of wood are too great. This expansion is very marked and causes destruction of the insulation, and finally of the whole vault. I should

Fig. 7. Histological Laboratory on the Second Floor.

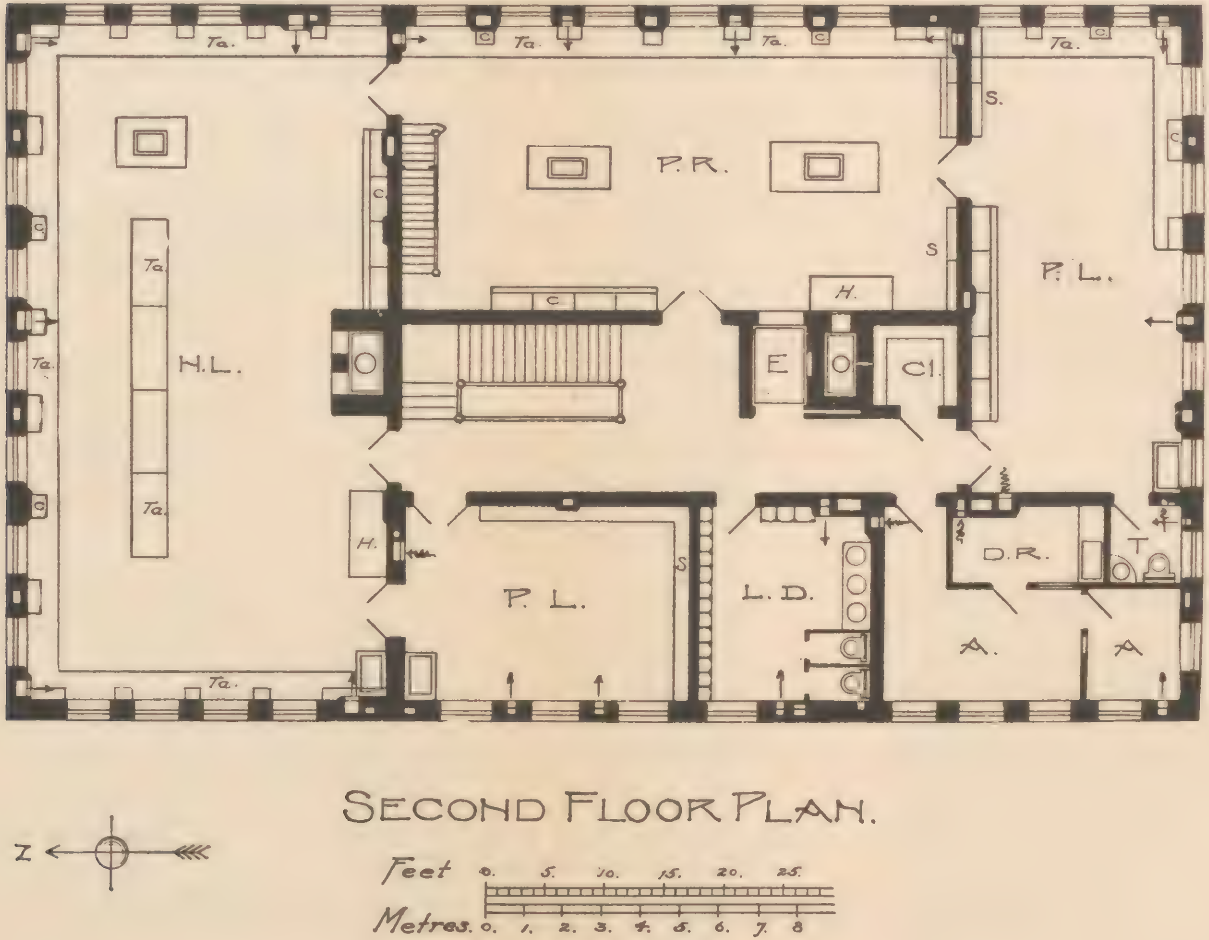

Fig. 6.

HL, Histological laboratory. *PR*, Preparation room. *PL*, Private laboratory. *DR*, Dark room. *A*, Light room. *A'*, Projecting room. *LD*, Women's dressing room. *T*, Toilet. *H*, Hood. *C*, Cases. *S*, Shelves. *Ta*, Table. *E*, Elevator. *Cl*, Closet.

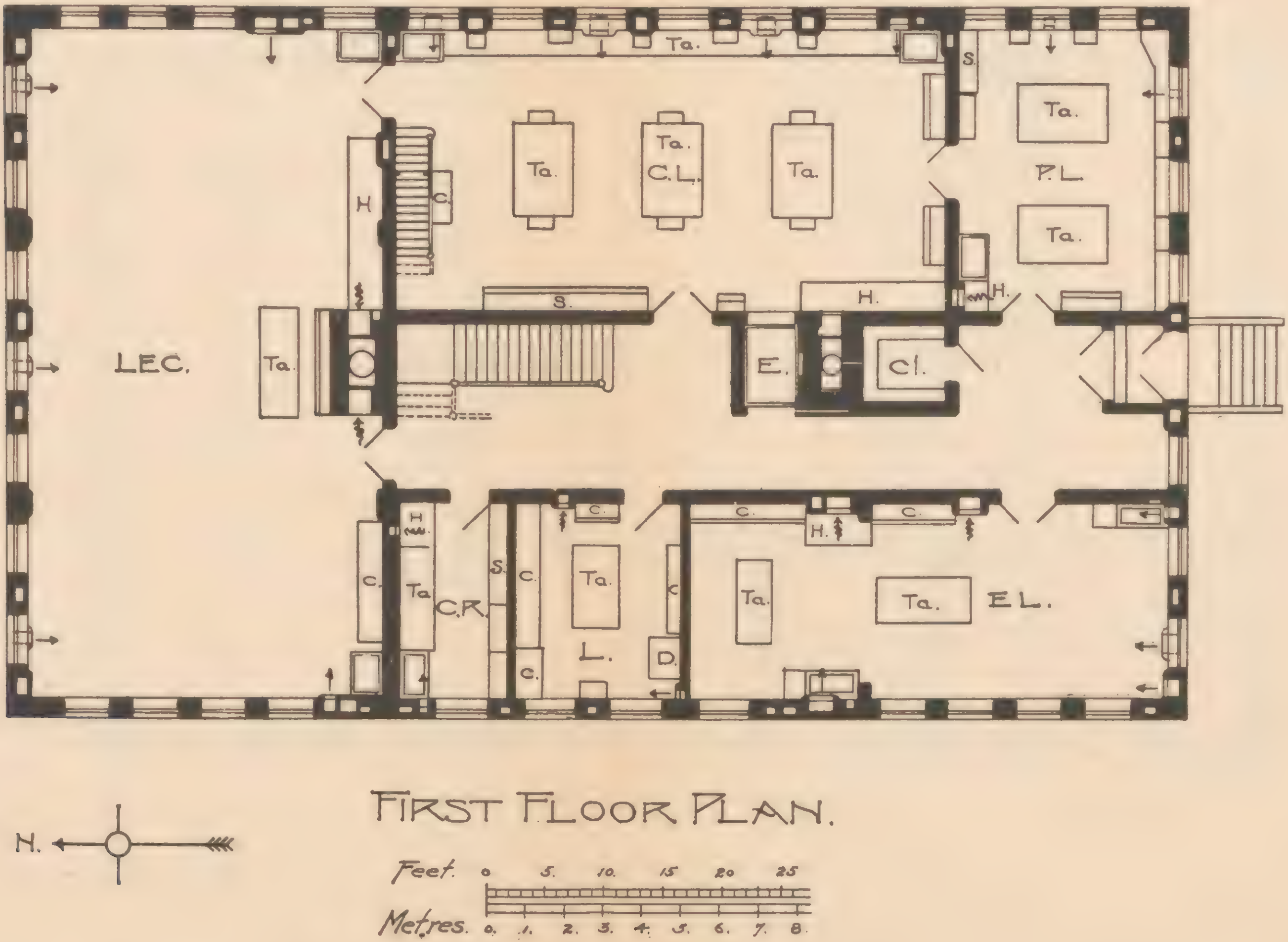

FIG. 5.

LEC, Lecture room. *CL*, Chemical laboratory. *PL*, Private laboratory. *EL*, Experimental laboratory. *L*, Library. *CR*, combustion room. *Cl*, Closet. *H*, Hood. *C*, Cases. *Ta*, Tables. *S*, Shelves. *D*, Desk. *E*, Elevator.

also cover the floor with zinc or some metal and have it drained. It is necessary to clean the vault about once a year, and the extensive thawing is very injurious to the floor.

Ground Floor.—The first floor is occupied temporarily by the Pharmacological Department. It contains a large room ultimately intended for microscopical work, but at present used as a lecture room. There is also a combustion room, a library, a chemical laboratory, an experimental room, and a private room. Through the kindness of Professor Abel the experimental room is used by the advanced workers in anatomy. It is fitted up with the necessary apparatus for registering blood pressure, for artificial respiration, and so on. The motor-power is obtained from the engine in the basement.

Histological Laboratory.—The histological laboratory is constructed with light on three sides in order to have the maximum working space. The main side faces north (Fig. 6). In all there are 15 windows in the room, giving window space for 30 students. The east end of the room is shown in Fig. 7. The full capacity of the room is 50 or 60, the additional students to be placed in the middle of the room. Each student is furnished with the necessary outfit and a Leitz microscope, Stand II, with Abbe condenser. Students are permitted to take the microscope from the building, as each one is personally responsible for everything placed in his charge. Each student has also a dissecting microscope.

The lectures are given in the laboratory with necessary charts, models, and gross as well as microscopic specimens to elucidate the subject. Whenever necessary, as in the case of the medulla oblongata, they are all taken into the photographic room, which is practically the interior of a microscope, and are shown what they are expected to study.

It is the aim of this course to illustrate the general anatomy, as is often the case in systematic lectures, with demonstrations and specimens. During the first half of the course fresh specimens are studied almost altogether, and throughout the course frozen sections are given the class with each organ.

We have a great abundance of pigs' embryos, which can be obtained by the hundred every day. These are used a great deal in studying the histogenesis of the organs.

In addition to the systematic course given there is an optional course in technique. The class is divided into groups of ten, and each group takes up a class of tissues like the alimentary canal, and so on. The course is not the same from year to year, and this variation proves to be most instructive to the students. They enter the course with enthusiasm and profit a great deal by it. They aid materially also in the preparation of the specimens for the class. Although this course is optional, practically all the students take it.

Throughout the course students are encouraged to read a few special monographs. They soon grow beyond the textbooks, and by this reading gain a much better idea of the scope of histology. We find that with the research method of teaching we can lead the student much further into the subject than without it. Students do better work when you expect much of them than when you expect little.*

Preparation Room.—The preparation room is located conveniently about the center of the building, and is used for all the work of the advanced students, and for the preparation of the specimens for the histological course (Fig. 6, *PR*, Fig. 8). It is fitted up with the necessary apparatus for the work—a set of Grübler's stains† and other reagents; ordinary microtomes of Thoma‡ and Schanze;§ the Minot microtome by Zimmermann,‖ and the CO_2 freezing microtome of Bausch and Lomb.¶ In addition to the large injecting apparatus in the embalming room, this room contains the apparatus of Ludwig for fine injections made by Petzold.** The hood, arranged with hot and cold water and well ventilated, is intended primarily for the making of corrosion specimens; it also contains the automatic water still by Stoelting.†† There is also an incubator and a large paraffin oven, both made by Keen

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* The details of this course are given by Barker and Bardeen, Johns Hopkins Hospital Bulletin, Baltimore, No. 62.

† Dr. G. Grübler & Co., Bayerische Str. 63, Leipzig, Germany.

‡ R. Jung, Landhaus Str. 12, Heidelberg, Germany.

§ M. Schanze, Bruder Str. 63, Leipzig, Germany.

‖ E. Zimmermann, Emilien Str. 21, Leipzig, Germany.

¶ Bausch & Lomb Optical Co., Rochester, New York.

** N. Petzold, Bayerische Str. 13, Leipzig, Germany.

†† C. H. Stoelting Mfg. Co., 128 South Clinton St., Chicago, Ill.

Fig. 8. South End of the Preparation Room on the Second Floor.

The apparatus and reagents which are used in common for all kinds of histological preparation are in this room.

& Hagerty.* The glassware of this room as well as all the jars of the building are after the same pattern, and have been made by Jahneke & Hofmann.† The jars are all ground flat on top, and are either fitted with flat lids with a knob or, as in the case of the large jars, with ground plate glass. Along the wall there are a number of lockers for advanced students' microscopes, etc.

In the center of the room are two large preparation tables, drained to a central sink, with hot and cold water and gas. These are extremely useful for all kind of work, from boiling of reagents, or making wax plates, to distilling alcohol. This room is among the most active in the building, and takes the place among the advanced students which the dissecting room does among the beginners. It is the general shop of the laboratory.

While there has been a great agitation in Europe for a *Studienzimmer*, I believe that the great need is just such a room as I have described for advanced students. We have also a study room, but it loses much of its force, because all the dissecting rooms are study rooms. Yet we have one room where the student can make shorter dissections and study preparations.

Photography.—Optical apparatus in connection with photography is such an essential to morphological research that before our laboratory was designed we purchased the large Zeiss outfit, with modifications similar to those I have had made for the University of Chicago four years ago. This apparatus had designed for it rooms as shown in Fig. 6, *A*, the idea being to enter the "camera" for all kinds of work.

We have, however, made a number of alterations in the electric light as well as in the screen for the reception of the picture projected. Dr. Hoen has had adjusted to the Zeiss apparatus a lamp of 4000 candle power, for alternating current, which is most satisfactory in every respect.‡ We have a set of lenses which enables us to enlarge any picture

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* Keen & Hagerty, Baltimore, Md.

† Jahneke & Hofmann, Frauenwald in Thür., Germany.

‡ Hoen, The Photographic Room of the Anatom. Lab., Johns Hopkins Hospital Bulletin, Nos. 62–63.

from one diameter to two thousand, and a movable screen aids us to obtain a given number of diameters easily, which is necessary for reconstruction work.

Our photographic lenses have been made by Zeiss, and they are interchangeable from the ordinary camera to the Zeiss camera, as well as to the lens holder on the large Zeiss projecting apparatus. This last arrangement enables us to use these lenses for the projection of histological sections as well as for lantern slides.

This room is perfectly dark, thus permitting us to expose a negative or a bromide by simply attaching it to a screen as described by His.* The screen we employ is movable and very simple in its construction. It is more fully described by Dr. Hoen. By opening the blinds daylight is admitted into both projecting and developing rooms. We thus have complete command of the light, enabling us to use the rooms for a variety of purposes.

Private Rooms.—The rooms marked *P*, *L*, and *A*, on the second floor, as well as three rooms on the south side of the third floor, are used as private rooms for advanced students at present. The arrangement of one of these is shown in Fig. 9. The fact that the furniture and cases are only loosely attached to the rooms enables us to rearrange the whole laboratory from time to time as circumstances demand.

Dissecting Rooms.—The traditional large dissecting room has been abandoned altogether. As a substitute for it we have nine small rooms, the largest one to hold eight or ten dissecting tables, while the smallest room holds but one table. The upper floor was at first constructed as two large and two small rooms, and after the building was finished the additional rooms were made by inserting thin partition walls, as shown in Fig. 10. This arrangement facilitates enlarging the rooms at any time if necessary.

The criticism has frequently been made that it is difficult to discipline the students if an instructor is not always present. Our experience proves that this is not the case, as the students remain quiet and orderly without the presence of the instructor. They know that their only opportunity of learning

*His, Mikrophotographisches Apparat d. Leipziger Anatomie, Leipzig, 1892.

Fig. 9. A Private Laboratory on the Second Floor.

FIG. 11. INSIDE VIEW OF ONE OF THE DISSECTING ROOMS ON THE THIRD FLOOR

anatomy is in the dissecting room, and generally utilize it. The universal opinion of the students is in favor of small rooms, and most of them prefer the rooms with but one table. The same order is insisted upon for the dissecting room as for the lecture room, and all are agreed that it is for the best. I allow the students to arrange their own dissecting classes, and always favor the good students by placing them in a room by themselves whenever possible. No smoking or loafing is permitted, and this again favors the work of the student.

Each room is fitted up with tables, chairs, book racks, hot and cold water, a sink, model cases, and a blackboard. In fact each is a study room by itself. Fig. 11 shows a corner of one of the smaller rooms. The floors are of Georgia pine, and are saturated with paraffin once a week, and are usually kept very clean. As soon as they become slightly soiled they are scrubbed with lye and saturated with paraffin again. Each room has a skylight, which, with the addition of the great number of windows, gives a most excellent light in all parts of the room.

The subjects come into the room vaselined and wrapped as described. The extremities are kept wrapped with the vaseline until the skin is removed, and when the body is cut the muscles are kept from drying by means of moist, but not wet, cloths. An excessive moisture favors decomposition and also soils the floor.

The course in practical anatomy begins immediately after the completion of the brief course on osteology. At the beginning of the session each student is loaned a skeleton for the year and also assigned a place in the histological laboratory. The latter entitles him to an outfit and the use of a Leitz microscope, Stand II, with an Abbe condenser, eye-pieces I and III and objectives 3 and 7. During the second year a $\frac{1}{12}$ oil immersion is added to the microscope. He thus has the use of a good microscope throughout his student time at this University.

During October the beginners are requested to arrange themselves into groups of twos or fours to aid the instructor in making up the dissecting classes. The first subjects are dissected by six students, the two on the head being second

year students and working on alternate forenoons. The beginners start on the abdomen and chest. The weekly task placed before each student during the winter is about as follows. It must be remembered, however, that after the dissection is fairly well started each student works for himself and by himself.

In the following chart Class No. III is composed wholly of second-year students. First-year students, who begin with Class No. I, usually dissect the whole body in 22 to 26 weeks. About one-half of the first-year students do not dissect the head until the second year.

All of the students have had one year each of physics, chemistry and biology before coming to us. Most of them have had a course in practical embryology. The course in embryology at this University is given during the spring of the year.

John Hunter has expressed himself that the only way to learn anatomy was by dissection and dissection and dissection. We believe firmly in this method and add to it *concentration*. If any one desires to know the very essence of an investigator's spirit let him read the introduction of v. Baer's Embryology.* The feelings of a scholar are expressed on every page. His association with his instructors meant so very much to him. Later, in his autobiography,† he rehearses the early period of his life and says: "Often during my life then,‡ as well as later,§ have I doubted the wisdom of our university courses. It seemed to me that the whole system was wrong in that it compels us to take a number of courses for 45 minutes at a time in order to convert our information into a heterogeneous mass. Would it not be better if we could study one subject after the other, so that we could busy ourselves with one, or at the highest two, subjects continuously for several weeks?" He continues this thought further, and finally states that whenever we wish to do anything thoroughly we do one thing at a time.

* v. Baer, Entwicklungsgeschichte der Thiere, Königsberg, 1828.

† v. Baer, Nachrichten über Leben und Schriften, St. Petersburg, 1866.

‡ 1815.

§ [illegible].

APPROXIMATE ARRANGEMENT OF THE COURSES IN GROSS ANATOMY AND IN HISTOLOGY.

Week.	20 to 30 Hours per Week.			15 Hours per Week.	Week.
	Osteology.			Histology.	
1	Spinal column			Vegetable cell and fibers	1
2	Upper extremity			Animal cells, egg and germ layers.	2
3	Lower extremity				3
4	Head			Cartilage and muscle	4
5	Head			Neuron	5
6	Head			Blood	6
	Class I.	Class II.	Class III.		
7	Abdominal walls	Chest walls	Superficial neck	Blood-vessels, lymph and lymphatics	7
8	" viscera	Axilla	Deep neck	Bone	8
9	" "	"	Face	Connective tissue fibrils	9
10	Lumbar plexus and thigh	Front of arm	Sympathetics and heart	Muscle	10
11	Back and gluteal region	Back	Back of neck.	Alimentary canal	11
	Body divided.		Arm removed.		
12	Perineum (*pelvis cut*)	Back of arm	Temporal and frontal region	Alimentary canal	12
13	Thigh	Remove muscles	Muscles of mastication & nerves	" "	13
14	Leg and foot	Class I.	Tongue and larynx	Urinary organs	14
15	Remove muscles		Base of skull	Reproductive organs	15
16	Class II.		Eye	Skin and nose	16
17			Class I or II, or Special Dissection.	Eye and ear	17
18				Spinal cord	18
19				Medulla oblongata	19
20				Medulla oblongata	20
21				Brain	21
22				Brain	22

As a student I demanded the privilege of studying one subject at a time and was often envied by my fellow-students. The privilege I then demanded I now gladly give my students and am extremely well gratified with the result. Continuous individual instruction is not easy and takes much time, yet I believe that I can carry the plan through with a much greater number of students than I now have.

At present we devote 22 continuous weeks to gross anatomy and histology exclusively during the first year, and about the same time to the dissecting room during the second year. In later years the students may continue to dissect, and if they are especially desirous of studying a number of parts at the same time they are employed as student demonstrators.

Our dissecting room is open every day from Monday morning until Saturday evening, and with a class of 70 we have an average attendance of 30 students during all this time.

Each student keeps a complete record of all the nerves he dissects, and when he has finished the parts he is examined on what he has dissected before the muscles are removed. I keep on file a card for each dissection which ultimately receives all the notes the instructors have made of the quality of his work. This gives us a permanent record of all the work which is done by the student in our laboratory.

With all this precaution we still have poor students. First and foremost we are careful to admit only those students who have had a good training,* and then when they come to us

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* From the Announcement of the Johns Hopkins Medical School, for 1895–96:

As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.

2. Graduates of approved colleges or scientific schools who can furnish evidence: (*a*) That they have a good reading knowledge of French and German; (*b*) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as employed in this university, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory; in chemistry and biology four class-room exercises and five hours a week in the laboratory in each subject are required.

we give them an opportunity to work. Some, however, are not bright, and a few others are not inclined to work. They, of course, do not accomplish much, and I should feel inclined to hold our method of instructing them in anatomy responsible for it were it not that they do equally poor work in other departments where the lecture method is employed.

Many inquiries have been received regarding the character and amount of the requisite training indicated by the term "Minor Course" in these sciences. In explanation, it may be stated, with respect to Biology, that the candidate should have followed for at least a year a laboratory course in the structure, life history, and vital activities of selected types of animal and vegetable life. In the Chemical-Biological course for undergraduates in this university the laboratory work in biology at present includes the study of such types as amœba, hæmatococcus, yeast, penicillium, bacteria, mushroom, hydra, vorticella, a fern, a flowering plant, the earthworm, lobster, anodon; the gross and minute anatomy of the frog, the development of its eggs, the structure, formation, and metamorphoses of the tadpole; the study and drawing of the bones of the human skeleton; the comparison of some parts of related vertebrate skeletons; dissection of a mammal; the field and laboratory study of some few flowering plants. The laboratory work is the more important part, the lectures and other exercises subsidiary. It is, of course, not to be understood that this curriculum of biological work must be rigidly followed. Equivalent work will be accepted.

The candidate should have followed a course in general Chemistry for at least a year. This course should include laboratory work, about five hours a week through the year, and lectures and class-room work covering the outlines of inorganic chemistry and the elements of organic chemistry. A good knowledge of the subject as presented in Remsen's "Introduction to the Study of Chemistry" may be regarded as the minimum requirement. A fuller knowledge of Chemistry is, of course, desirable.

In Physics, the candidate should have followed a collegiate course for at least one year. This should include four hours a week of class-room work and at least three hours a week of quantitative work in the laboratory. Special attention should be given to theoretical mechanics and to the mechanical and electrical experiments.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, physics, chemistry, and biology above indicated.

Study Room.—In recent years there has been an agitation in favor of teaching anatomy by means of a study room. This method is practiced in many universities by placing the objects used to illustrate a lecture at the disposal of the student after the hour; he can then take the specimen in his hand and see for himself. A few students utilize this opportunity, but it is only of much value to advanced students.

If now all these specimens and models are placed together in one room which is at the disposal of the student, we have the study room as arranged by Rauber* in the University of Dorpat, or by Kollmann† in the University of Bâle. Similar methods of instruction are employed in the Austrian universities, and I have observed their use in Professor Toldt's laboratory in Vienna. Professor Drasch of Graz also informs me that they were used extensively while he was a student. We are all familiar with the excellent exhibitions of anatomical specimens in the English laboratories and museums and appreciate fully their importance as recently emphasized by Prof. Keiller.‡

A whole series of papers has been written during the last 20 years about the teaching of anatomy, and the universal opinion is in favor of teaching and studying at the same time;§ to study the object from every standpoint. There has been a marked revulsion against simply giving the students the *results* of anatomy—the favorite method in America to-day. The references just given will be very instructive to the advanced students of anatomy and I recommend that they be read freely.

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* Rauber, Entwicklung von Studiensäle, Leipzig, 1895.

† Kollmann, Archives des sciences physiques et naturelles, t. 28, 1892, and Verhandl. d. anatom. Gesellschaft, 1895.

‡ Keiller, New York Medical Journal, 1894.

§ His, Auffassung der organischen Natur, Leipzig, 1870; His, Aufgabe u. Zielpunkte der Wiss. Anat., Leipzig, 1872; Turner, Address at the Opening of the new Anatomical Department at the University of Edinburgh, 1880; Hertwig, Der anatomische Unterricht, Jena, 1881; Schiefferdecker, Der anatomische Unterricht, Deutsche Med. Wochenschrift, 1882; Kölliker, Die Aufgaben der Anatom. Institute, Würzburg, 1884; Waldeyer, Wie soll Man Anatomie lehren und lehrnen, Berlin, 1884.

Fig. 12. Northwest Corner of the Study Room on the Third Floor.

The case shown contains the wax models made by Ziegler. The main part of the room is devoted to the study of models and finished dissections.

In the early part of this century Rudolphi* wrote an essay on the various methods of learning anatomy and gives an extensive literature on the subject. "Yet," he says, "it is wholly indispensable for those who wish to study anatomy to make their own dissections, for the best preparations made by others, the best plates, etc., cannot take the place of specimens made by the students. It is altogether a different thing to have dissected the vessels and nerves for one's self and to have observed their relations, than to have simply seen the finished preparation in which the parts are more or less distorted." In this way Rudolphi continues in the most interesting manner.

In our laboratory we have set aside a large room as a study room, but find that there is no special demand for it as long as the students can make their own dissections. As soon as they have begun work it is easy to make them find most of the fine nerves as well as the sympathetics, and after the part is fully dissected it is taken to pieces systematically (and this is the review); then the ligaments are studied. We have made a study room of all of our dissecting rooms, and our *Studienzimmer* remains as a room for special and briefer dissections. It is fitted up with coarse vises for holding sheeps' heads and useful things of that kind. When students desire to study the peritoneal cavity of a lower animal, to dissect or macerate hearts, or to dissect sheeps' eyes, this room is used. Here they also study finished dissections and models which are at all times at their disposal. Throughout the dissecting rooms there are large cases in which are exposed many of the models and preparations of Ziegler,† Steger,‡ Benninghoven and Messing,§ Auzoux,|| Tramond,¶ as well as the wire models of Abbe and Edinger.

The finer preparations of bones are employed to elucidate the course in osteology, and there is an abundance of loose bones at the disposal of the instructors. In addition to excel-

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* Rudolphi, Ueber Anatomie, Berlin, 1828.

† Ziegler, Freiburg in Baden, Germany.

‡ Steger, Thalstr. 26, Leipzig, Germany.

§ Benninghoven and Messing, Dorotheenstr. 38, Berlin, Germany.

|| Auzoux, Rue de Vaugiard 56, Paris, France.

¶ Tramond, Rue de l'Ecole de Médecine 9, Paris, France.

lent mounted skeletons we have complete skeletons, which are loaned to the students for the whole year. If there is any breakage or loss of bones the student must pay for a new skeleton. The method of placing good specimens and instruments at the disposal of students works admirably when the responsibility of keeping them in good order rests upon the student. Whenever the student wishes to study the attachment of muscles or anything of that kind, a mounted skeleton is placed at his disposal in the study room.

The plan of the third floor shows the arrangement of the model and specimen cases. The models are well displayed and can be taken out easily to demonstrate any point as it may arise.

Lockers.—There are a number of hat and cloak hooks in the halls of the first and second floors, where students can lay off their wraps easily before going into the histological laboratory or the lecture room. On the third floor there are a number of lockers for men, with latches, but the padlocks must be supplied by the students if they desire to lock them. In the autumn the lockers are assigned to the students, who may retain them for one complete year, thus giving them a place to lock up their things during the summer. The lockers for the women are in a special room on the second floor. This room is also fitted up with a table, a few chairs, washstands with hot and cold water, and closets. The closets for the men are in the basement and the third floor, while in addition to these there is a private closet for each floor.

Store-rooms.—One of the most important adjuncts to a laboratory is an abundance of store room. There is on each floor a large hall room for the use of the janitor's utensils, laundry, and so on; each is well ventilated. In addition to the cold storage we have two rooms in the basement in which to keep alcohol specimens during the summer and at other times when they are not in use. The whole fourth floor is one large store room communicating with the elevator (Fig. 13). A glance at the plan will show the arrangement. The central hall is illuminated by all the skylights of the building, thus making it a very agreeable room to work in. In addition to this there are twelve large store rooms used for all kinds of bulky ware necessary in an anatomical laboratory. Special

rooms are set aside for glassware and others for chemicals. As we still import most of our equipment, it is necessary to lay in a stock for the whole year and to have an abundance of storing space. The alcohol and other very inflammable substances are stored in an underground vault outside of the building, which communicates with the basement. This enables us to procure a sufficient supply, duty-free, to last for a year. Under no conditions could we keep a large quantity of inflammable material on hand without such a vault, for it would be impossible to place an insurance upon the building.

Animal House.—One of the most difficult problems in the construction of a laboratory is the care of live animals. A number of methods are employed, and it matters little whether the animals are kept in the basement or the attic, they are a nuisance and hard to care for. When either of the above arrangements is made it is impossible to make any alterations in the room from time to time as circumstances demand. The simplest and easiest method is to construct a special animal house. Our animal house is completely separated from the building, and has its own yard in which the animals can run about. The house (as Fig. 14 shows) is divided into four rooms, each of which is ventilated by itself. There are hot and cold water in the large rooms, and all the floors are asphalted and drained. The rooms are heated by steam from the boilers in the main building. In addition one of the rooms has a large coal stove for heat during the night in cold weather. We can thus give animals every comfort and cleanliness, and find that under these conditions dogs are not very noisy. The house is practically a hospital for operated animals, monkeys as well as dogs.

A space has been set aside in the basement for aquaria, but they are yet to be constructed.

Macerating Rooms.—A large room on the fourth floor is fitted up especially as a macerating room. It has a special ventilating flue, a store room adjoining for clean bones, and a large balcony for bleaching and drying purposes (Fig. 13, *BB*). The room has hot and cold water as well as a special steam connection with the boilers in the basement. The skeletons which come from the dissecting rooms are placed in sacks and

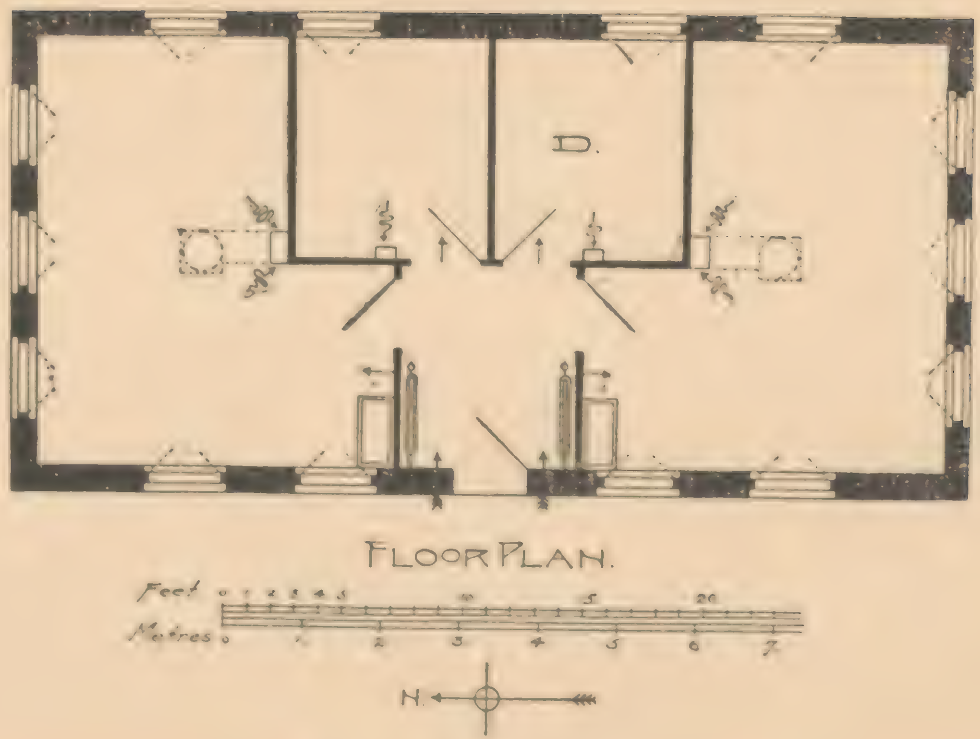

FIG. 14. THE ANIMAL HOUSE.

numbered, which in nearly all cases completes the record of each subject. The bones from the subjects embalmed with carbolic acid are cleaned with lime or 1 per cent acetic acid. In either case we must boil them; and this is easily done with steam. In addition to these skeletons we obtain subjects too far advanced in decomposition to embalm, and they are first frozen and then cleaned as soon as time will permit, often a year after the subject is obtained. All of the bones cleaned are preserved until summer, when the fat is extracted from them. Our extractor was made by Lentz,* and it is set up in the animal house for additional security in a room containing the alcohol stills. The water-bath of the apparatus is heated with live steam, which is easily controlled and is more satisfactory as well as safer than the gas flame. The apparatus can be started and may run for days without any special attention.

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